Integration of CoCoRaHS Data into WGRFC Operations

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West Gulf River Forecast Center
Texas Master Naturalist 2019 Annual Meeting
First, Who am I?

• I have been a meteorologist since 1976. Graduated from Northern Illinois University in 1976 (70 miles west of Chicago)
• Started out as a TV meteorologist from 1976 until early 1990.
• Joined the NWS in early 1990 as a forecaster in Shreveport LA.
• Have been with the NWS in Fort Worth, Texas since November 1993.
So what do I do now?

• I am a Hydrometeorologist at the NWS West Gulf River Forecast Center
• Am the North Texas Regional Coordinator for CoCoRaHS
• Past President of the North Texas Chapter of the American Meteorological Society and National Weather Association

Haltom City Tornado April 13, 2007
What is the National Weather Service?
People Think We Follow This Guy

I'm a rodent, not a meteorologist!
We are Federal Government Forecasters

United States
Department of Commerce

National Oceanic and Atmospheric Administration

National Weather Service

Weather Forecast Offices (WFOs) = Weather Forecasters
River Forecast Centers (RFCs) = Water Forecasters
NWS WFOs and RFCs

122 WFOs in the U.S. and territories

13 RFCs Nationwide
Our Weather Forecasting Motto

Making predictions is tough…especially if it’s about the future!

-Yogi Berra
People ask why we need the National Weather Service when we have the Weather Channel?

That’s like asking why we need Idaho potato farmers when we have all these French Fries at McDonalds…
The West Gulf RFC Area

- 402,000 mi² total area
- 87,000 mi² in MX (Rio Grande tributaries)
- 320 forecast points, 15 major river systems

- Prolonged river flooding
- Complex reservoir operations
- Rocky terrain
- Flash flood threats
- Rapid river responses
- Tropical threats
- Storm surges
- Coastal flooding

Snowpack Water supply
Main West Gulf RFC Duty: Make River Flood Forecasts

To accomplish this, we have Two work groups

- **HAS Operations** – Past, present and future precipitation data and forecasts
  - HAS = “Hydrometeorological Analysis and Support”
  - 3 HAS Forecasters at WGRFC – all meteorologists

- **Hydrologic Operations** – River data and forecasts
  - 8 Hydrologists at WGRFC – some are professional engineers

Research and development to augment and compliment operations

Development of new products and services

- **Advanced Services**
  - Inundation Mapping
  - Probabilistic forecasts

- Partnerships with government and private entities
Main West Gulf RFC Duty: Make River Flood Forecasts

- In our Hydrometeorological Operations, we have to estimate Past and Present precipitation.

**Question:**

What are the chances that any one rain gauge will catch the maximum rainfall in a thunderstorm?

And what are the chances the Doppler Radars will correctly estimate the maximum rainfall?
My Primary Job: Get the Best Estimate of Rainfall Possible! Here’s a WGRFC analysis…are we close? How Do we Know?
CoCoRaHS's main focus is to Collect Precipitation Data
What is CoCoRaHS?

(Community Collaborative Rain, Hail & Snow Network)

Volunteers who measure rain, hail and snow
How it started… Ft. Collins Flood
killed 5!
Millions of $ in damage!

Storm reports can save lives!
Why CoCoRaHS ??

“Because every drop counts”
Why CoCoRaHS ??

2010-2018 U.S. Flood Fatalities

Source: NOAA/National Weather Service
Precipitation is important and highly variable.

Data sources are few and rain gauges are far apart.
72,500 CoCoRaHS observers in the United States, Canada, Puerto Rico, U.S. Virgin Islands and the Bahamas.

• In Texas, 6,700+ signed up for CoCoRaHS since it began.
• Problem: Many people who signed up have passed on, lost interest or have moved. Thus new observers are simply replacing those who have retired.
On any given day, we receive 800 to 1,000 CoCoRaHS observations across the WGRFC area.

Often, the CoCoRaHS observations are the largest rainfall readings we receive.
A great example of one observation making a difference.

"All but 0.02" fell between 3:30 and 5:30PM."
CoCoRaHS web site allows for verifying multi-day rainfall estimates over a period of time.

Houston area, April 2016
Examples of how CoCoRaHS observations helped WGRFC Improve our Rainfall Estimates

1. Intense Rainfall Reports

While working one night, I received this report on the left...
Examples of how CoCoRaHS observations helped WGRFC improve our rainfall estimates.

Raw Radar. Santa Fe estimate 1.75” Best Estimate after adjustment.
Examples of how CoCoRaHS observations helped WGRFC Improve our Rainfall Estimates

Of course, the end goal is to get the proper amount of rainfall into our model and to our users.

The 24-Hour totals from the following morning are on the left.
2. Another Example of a CoCoRaHS observation helping us to “get it right”

The CoCoRaHS observer TX-EL-13, Maypearl 0.6 WSW, gave us a rainfall reading of 4.51 inches. Our initial WGRFC estimate for that location was 2.60 inches, or about \( \frac{1}{2} \) the amount that fell!
WGRFC 24-Hour Estimates after adjusting for the CoCoRaHS observations

We went back to the hours it rained in this location and increased our radar-based estimates. This allowed us to match the CoCoRaHS amount in real-time.
3. The 24 Hour Reports

Examples from Hurricane Harvey
This table shows the ten highest CoCoRaHS reports from 26 August 2017. The initial radar estimates ranged from 5 to 9 inches. However, the CoCoRaHS 24-hour readings had several contributors reporting 8.00 to 9.60 inches.
Example from Hurricane Harvey

WGRFC final estimate of rainfall from MPE the first day of hurricane Harvey, 26 August 2017, after MPE was raised.
Example from Hurricane Harvey

<table>
<thead>
<tr>
<th>LID</th>
<th>GAGE</th>
<th>MPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXGV44</td>
<td>21.62</td>
<td>12.90</td>
<td>Bacliff 0.5 SSE</td>
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<tr>
<td>TXHRR32</td>
<td>20.84</td>
<td>12.90</td>
<td>South Houston 4 SSW</td>
</tr>
<tr>
<td>TXHRR93</td>
<td>20.54</td>
<td>12.90</td>
<td>Pasadena 4.4 WNW</td>
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<td>TXHRR31</td>
<td>19.41</td>
<td>12.90</td>
<td>Friendswood 2.5 NNE</td>
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<td>TXGV60</td>
<td>19.38</td>
<td>12.90</td>
<td>Santa Fe 0.7 S</td>
</tr>
<tr>
<td>TXGV64</td>
<td>18.20</td>
<td>12.90</td>
<td>Hitchcock 1.6 NNW</td>
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<tr>
<td>TXHRR139</td>
<td>17.98</td>
<td>12.90</td>
<td>Cloverleaf 1.7 W</td>
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<td>TXGV51</td>
<td>17.57</td>
<td>8.74</td>
<td>La Marque 1.8 E</td>
</tr>
<tr>
<td>TXHRR28</td>
<td>17.00</td>
<td>12.90</td>
<td>Webster 0.4 NW</td>
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<tr>
<td>TXGV63</td>
<td>16.59</td>
<td>12.90</td>
<td>Friendswood 1 SE</td>
</tr>
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</table>

The ten highest CoCoRaHS reports ending at 12Z on 27 August 2017. The data indicate five readings in excess of 19.25 inches that corresponded to initial MPE estimates of just under 13 inches over parts of Harris and Galveston Counties in southeast Texas.
Example from Hurricane Harvey

The final MPE estimate field from 12Z on 27 August 2017. There was a sizable increase in the areal coverage of the heaviest rainfall over the initial estimates.
Based on the CoCoRaHS observations, the initial MPE estimates were too low for the remainder of the Harvey storm event. The final daily rainfall estimates for Harvey from August 28 – 31 are shown above.
Example from Hurricane Harvey

Had it not been for the CoCoRaHS observations it would have been more difficult to determine the tremendous amounts of rain that fell.
CoCoRaHS Reports – TS Erin 2007

Daily Precipitation (Inches x.x), for the 24 hour period ending 7:00 am
Bexar County, Texas 8/17/2007

7 to 8 inches
NW Bexar County

CoCoRaHS reports confirmed our original estimates!
10 inches
Kendall County!
Text Product Comparing CoCoRaHS Data to Raw Radar Estimates

More CoCoRaHS rainfall observers would help our verification!
Graph Comparing CoCoRaHS Data to Raw Radar Estimates

More CoCoRaHS rainfall observers would help our verification!
Bottom Line: We Need More CoCoRaHS Observers!
Once trained, our volunteers collect data using low-cost measurement tools . . .

4-inch diameter high capacity rain gauges

Aluminum foil-wrapped Styrofoam hail pads

Training is important to assure accurate, high quality data
and report their daily observations on our interactive Web site: www.cocorahs.org
Volunteer’s observations are immediately available in map and table form for the public to view.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Station Number</th>
<th>Station Name</th>
<th>Total Precip Snow in.</th>
<th>New Snow in.</th>
<th>Total Snow in.</th>
<th>State</th>
<th>County</th>
<th>View</th>
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<tr>
<td>8/17/2013</td>
<td>7:00 AM</td>
<td>TX-BRZ-23</td>
<td>Marvel 3.2 NW</td>
<td>1.92</td>
<td>NA</td>
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<td>TX-WH-4</td>
<td>El Campo 1.0 NW</td>
<td>1.86</td>
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<td>8:00 AM</td>
<td>TX-WH-11</td>
<td>El Campo 2.7 NW</td>
<td>1.81</td>
<td>NA</td>
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<td>Wharton</td>
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<tr>
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<td>8:10 AM</td>
<td>TX-MNG-35</td>
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<td>7:00 AM</td>
<td>TX-WH-5</td>
<td>El Campo 2.5 WSW</td>
<td>1.59</td>
<td>NA</td>
<td>NA</td>
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<td>7:00 AM</td>
<td>TX-HRR-91</td>
<td>Tomball 2.7 SSE</td>
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<td>TX-WH-2</td>
<td>El Campo 4.9 SSE</td>
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<td>TX-BRZ-25</td>
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<td>NA</td>
<td>NA</td>
<td>TX</td>
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<td>8:30 AM</td>
<td>TX-WH-10</td>
<td>El Campo 0.5 ENE</td>
<td>1.43</td>
<td>NA</td>
<td>NA</td>
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<td>8/17/2013</td>
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<td>TX-HRR-120</td>
<td>Spring 10.0 WSW</td>
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<td>TX-CML-48</td>
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<td>Comal</td>
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<tr>
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<td>Sylvester 0.2 SE</td>
<td>1.25</td>
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<td>NA</td>
<td>TX</td>
<td>Fisher</td>
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<td>TX-MNG-29</td>
<td>Spring 4.2 N</td>
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<td>TX-HRR-159</td>
<td>Jersey Village 3.0 N</td>
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<td>NA</td>
<td>NA</td>
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<tr>
<td>8/17/2013</td>
<td>7:00 AM</td>
<td>TX-ER-1</td>
<td>Stephenville 1.2 NW</td>
<td>1.09</td>
<td>NA</td>
<td>NA</td>
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<td>8/17/2013</td>
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<td>TX-CLH-12</td>
<td>Port Lavaca 6.8 W</td>
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<td>NA</td>
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<td>8/17/2013</td>
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<td>TX-BXR-225</td>
<td>Castroville 9.2 NE</td>
<td>1.02</td>
<td>NA</td>
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<td>TX</td>
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<td>8/17/2013</td>
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<td>Port Lavaca 0.9 NW</td>
<td>1.01</td>
<td>NA</td>
<td>NA</td>
<td>TX</td>
<td>Calhoun</td>
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<tr>
<td>8/17/2013</td>
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<td>Wharton 0.3 E</td>
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<tr>
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<td>TX-FB-28</td>
<td>Missouri City 7.5 SSE</td>
<td>1.00</td>
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<td>NA</td>
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<td>Fort Bend</td>
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<tr>
<td>8/17/2013</td>
<td>7:00 AM</td>
<td>TX-MNG-28</td>
<td>The Woodlands 2.8 N</td>
<td>0.99</td>
<td>NA</td>
<td>NA</td>
<td>TX</td>
<td>Montgomery</td>
<td></td>
</tr>
</tbody>
</table>
Volunteer’s observations can be compared to other rainfall readings through the WGRFC 24 hour rainfall collective.

https://forecast.weather.gov/product.php?site=NWS&issuedby=FWR&product=HYD&format=CI&version=1&glossary=0
And there are educational opportunities

“Helping to provide the public with a better understanding of weather”
CoCoRaHS data is used by many

- National Weather Service
- Other Meteorologists
- Hydrologists
- Emergency Managers
- City Utilities
  - Water supply
  - Water conservation
  - Storm water
- Insurance adjusters
- USDA—Crop production
- Engineers
- Scientists studying storms
- Mosquito control
- Farm Service Agency
- Ranchers and Farmers
- Outdoor & Recreation

- Teachers and Students
  - Geoscience education tool
  - Taking measurements
  - Analyzing data
  - Organizing results
  - Conducting research
  - Helping the community
Example: CoCoRaHS data is used to determine drought severity

**U.S. Drought Monitor**

**Texas**

**March 25, 2014**

*(Released Thursday March 27, 2014)*

*Valid 7 a.m. Eastern*

Statistics type: ◆ Traditional (D0-D4, D1-D4, etc.) ◆ Categorical (D0, D1, etc.)

Drought Condition (Percent Area):

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Nothing</th>
<th>D0-D4</th>
<th>D1-D4</th>
<th>D2-D4</th>
<th>D3-D4</th>
<th>D4</th>
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<tbody>
<tr>
<td>Current</td>
<td>3/25/2014</td>
<td>14.73</td>
<td>85.27</td>
<td>67.43</td>
<td>41.85</td>
<td>24.97</td>
<td>3.48</td>
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<tr>
<td>Last Week</td>
<td>3/18/2014</td>
<td>15.24</td>
<td>84.76</td>
<td>64.20</td>
<td>33.18</td>
<td>14.06</td>
<td>1.41</td>
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<tr>
<td>3 Months Ago</td>
<td>12/24/2013</td>
<td>28.30</td>
<td>71.70</td>
<td>45.90</td>
<td>22.44</td>
<td>6.78</td>
<td>0.79</td>
</tr>
<tr>
<td>Start of Calendar Year</td>
<td>12/31/2013</td>
<td>28.40</td>
<td>71.52</td>
<td>43.04</td>
<td>21.15</td>
<td>5.82</td>
<td>0.79</td>
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<tr>
<td>Start of Water Year</td>
<td>10/1/2013</td>
<td>5.62</td>
<td>93.38</td>
<td>70.95</td>
<td>25.09</td>
<td>4.01</td>
<td>0.12</td>
</tr>
<tr>
<td>One Year Ago</td>
<td>3/25/2013</td>
<td>1.40</td>
<td>98.60</td>
<td>87.26</td>
<td>62.02</td>
<td>29.74</td>
<td>10.54</td>
</tr>
</tbody>
</table>

View More Statistics

Intensity:

- **D0** - Abnormally Dry
- **D1** - Moderate Drought
- **D2** - Severe Drought
- **D3** - Extreme Drought
- **D4** - Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying **text summary** for forecast statements.
How Can You Become Part of the Network?

Five easy steps

Simply sign-up on the CoCoRaHS web page
www.cocorahs.org
(Internet or Smartphone required)

Obtain a 4” plastic rain gauge
(info available on web site)

View the “training slide show” or attend a training session

Set-up the gauge in a “good” location in your backyard

Start observing precipitation and report on-line daily
CoCoRaHS hopes to one day achieve a network of . . .

one observer **every square mile**
in **urban** areas

one observer **every 36 square miles**
in **rural** areas
Anyone can join!

All that is needed is:

An interest
A CoCoRaHS gauge
An open spot
Internet access
If you would like to help…

1. Fill out the application online at:

   www.cocorahs.org

2. We’ll find your location (latitude, longitude)

3. You agree to collect data

4. Send your report via www.cocorahs.org
   Then click on Texas to see your data
The Most Interesting Man in the World says…

I Didn't Always Measure Precipitation,

But now I do and I report it on COCORAHs.org
This presentation has a shocking conclusion
Thank you!

• Remember:

• Every Drop Counts & Zeros do too!
Questions???

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